

# **ON A TANKFUL OF BEANS Human Powered Transport**

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### **Introduction**

The notion of inserting payloads into individual containers many orders of magnitude heavier in order to move them may be appropriate for space satellites. From an energy perspective it is a bizarre approach to moving hordes of people short distances within urban areas. Sometimes the “payload” may not even be a person or persons, but could be for instance just a carton of milk or a pizza, with a 75 kg person driving it being in that case an integral part of the container, a 1500 kg (or more) car.

In a world of plentiful and cheap energy, such arrangements are considered normal and natural. This Symposium is considering future scenarios where present conditions of energy availability and cost no longer apply, at least as far as oil is concerned.

Today, energy availability for both personal and commercial transport is effectively unrestrained. Of the two, commercial transport is more important in making desired urban lifestyles possible, while personal mobility with cars is a generally desired feature of that lifestyle. What will happen if and when oil supply starts to tighten or cost more?

Undoubtedly bulk movements of minerals, manufactures, food, beer and all other essential commodities will eventually require both technological ingenuity and logistical optimisation if they are to continue in an

affordable way. The same observation applies to longer-distance personal travel.

Movement of other commodities, such as household waste, may be greatly reduced by behavioural changes or non-transport technology. This also applies to personal travel to some extent.

This paper considers another possibility for shorter-distance personal travel, namely maintaining accessibility and mobility using the traveller himself/herself as the power source. This could reduce the energy demand of the personal sector, thereby complementing the probably inevitable shift in priorities towards the commercial. The issues in play that constrain or promote opportunities are much more socio-economic or behavioural, or both, than technical.

### **Walking-and-Cycling**

The majority of person trips in big cities in Australia are short.

- In Sydney, 21% of weekday trips and 16% of weekend trips are made on foot (19% overall). Car use predominates, accounting for 68% of weekday trips and 78% of weekend (71% overall).
- One third of trips by car in Sydney are less than three kilometres in length.
- Over half of all urban car trips in Sydney take less than 10 minutes, both weekday and weekend.
- Bicycle use is currently negligible in Sydney - around 0.6% of all trips.
- In Melbourne, 16% of all trips are made on foot. Car use accounts for 75% of trips.
- Half of all trips in Melbourne (by any mode) are less than 2.9 kilometres and take less than 10 minutes.

Simple calculation suggests that trips less than three kilometres by car may equate to about 7% of car travel (vehicle km) in Sydney and hence, roughly, 7% of fuel use. Melbourne appears similar. Metropolitan fuel use by road transport has been estimated as about 3,400 million litres per year in Sydney (1991) and about 3,000 million litres per year in Melbourne (1995). Hence around 200-240 million litres per year in petrol and diesel are

consumed in each city by vehicles making trips which are less than three kilometres in length.

Walking and cycling are two readily available alternatives for short car trips, generally neglected by “serious” transport planners. Often they are treated together in strategic plans, “walking-and-cycling”, though the two are quite different.

Even within cycling, there are quite distinct categories - regular commuters (whose speed in an urban area will be considerably higher than that of most passengers in buses, over distances much longer than the arbitrary three kilometres mentioned above), older children developing independent mobility, people on recreational trips, athletes in training, and other groups. The everyday utility rider tends to be missing from the Australian mix at present. But car users are seldom considered in terms of such subgroups, and this paper is not over-concerned with their individual characteristics.

The potential for increasing walk trips is closely related to land use planning and urban design. If things are close enough together, and conditions are safe and pleasant enough, more walking is an option open to most people.

Cycling is more complex, although the same considerations of course apply. At a recent workshop session in Sydney, participants were asked to identify barriers to greater cycle use. The range was wide, with the principal factors being :

- safety concerns
- lack of connected networks
- lack of inter-modal integration
- political forces (e g vested interests hostile to encouragement of cycling)
- cultural attitudes

(This suggests that institutional structures are a large influence in urban areas.)

As well as conventional bicycles, there are a number of other human-power options including pedicabs, rickshaws, multi-person

machines, three- or four-wheeled freight movers, and egg-shaped vehicles designed for speed. Power-assisted bicycles also present options. Much of the use of bicycle paths in the Netherlands, for instance, is not by *fiets* (a bicycle) but *bromfiets* (or *brommer* - a *fiets* that *broms*, ie a moped). These can reduce the barriers to cycling for the unfit or those living in hilly areas. If the definition of “cycling” is considered to be a broad one, most of the above can be considered under one inclusive heading.

The Industry Commission (1994) estimated the energy consumption per person-kilometre for various modes of transport as:

single-occupant car	4800-5800 kj
double-occupant car	2500-3000 kj
pedestrian	200-260 kj
bicycle	90-210 kj

The question is now this : if in future there were a dramatic reduction in the availability, or dramatic increase in the price, of oil, could human-powered transport mitigate the effects to a significant degree in Australian cities - and if not why not ?

#### Urban Travel

Consideration of who cycles and why identifies the large age and gender bias inherent in this mode in Australia relative to some other countries.

**Table 1** (all trips) and **Table 2** (work trips only) summarise the modal breakdown of trips on the average weekday in Greater Sydney in 1991. It is evident that while the broad split between cars, public transport and green modes is the same for males and females, there are subtle sub-modal biases. For car users, women are more likely to be passengers than men, and men more likely to be drivers. For public transport users, women are more likely to be on buses than men, while trains are more evenly used. And for green modes, the bias is not at all subtle. 84% of cycle trips are made by males.

**Table 1 Weekday modal shares in Greater Sydney, 1991 (all trips)**

Mode	Males	Females	All
Private Transport %	70.7	67.1	68.9
Public Transport %	9.5	10.7	10.1
- train	4.3	4.3	4.3

- bus	4.5	5.6	5.0
- other	0.7	0.8	0.8
Green Modes %	19.8	22.2	20.9
- walking	18.4	21.8	20.0
- cycling	1.4	0.3	0.9
Total trips (000)	8,000	7,400	15,400

Notes

Source : RTA Home Interview Survey 1991  
sub-mode split for all trips, private transport not available  
trips involving both bus and train, car and train etc counted as train trips

**Table 2 Weekday modal shares in Greater Sydney, 1991 (work trips)**

Mode	Males	Females	All
Private Transport %	76.1	68.0	72.8
- car driver	68.1	55.8	63.1
- car passenger	6.3	11.7	8.5
- other	1.7	0.5	1.4
Public Transport %	18.3	25.6	21.2
- train	13.0	16.0	14.3
- bus	4.2	8.3	5.9
- other	1.0	1.2	1.1
Green Modes %	5.6	6.5	5.9
- walking	4.5	6.4	5.2
- cycling	1.1	0.1	0.7
Total trips (000)	900	600	1,500

Notes

Source : 1991 Census  
trips involving both bus and train, car and train etc counted as train trips

**Table 1** and **Table 2** showed 1991 data, to enable direct comparison of journeys to work and all journeys. The 1996 Census updated the picture for journeys to work, as shown for Greater Sydney in **Table 3**. The change is dominated by more female workers entering the workforce, the rise of homework and/or part-time work and, for those who do travel to work, huge increases in car driving and decline in use of all other modes. The increase in female car-borne mobility can be expected to have a similar but perhaps lesser effect on the "all trips" pattern, for which no corresponding update is available. Parker (1998) showed that similar work trip trends are found in all Australian cities.

**Table 3 Changes in weekday journey to work (000), Greater Sydney, 1991-96**

mode	males	females	all
car drivers	+37	+62	+99
car passengers	-1	-1	-2
public transport	-4	+3	-2
green modes	-4	-4	-8
subtotal : travellers on census day	+28	+60	+87
homeworkers or non-workers on census day	+19	+27	+47
total workforce	+48	+87	+134

Sydney is perhaps the least cycle-friendly capital in Australia, but other cities are not dramatically different. Perth has achieved the highest mode share, with 5.7% of daily trips made by bicycle and the target of increasing this to 8% by 2010 and 11.5% by 2029.

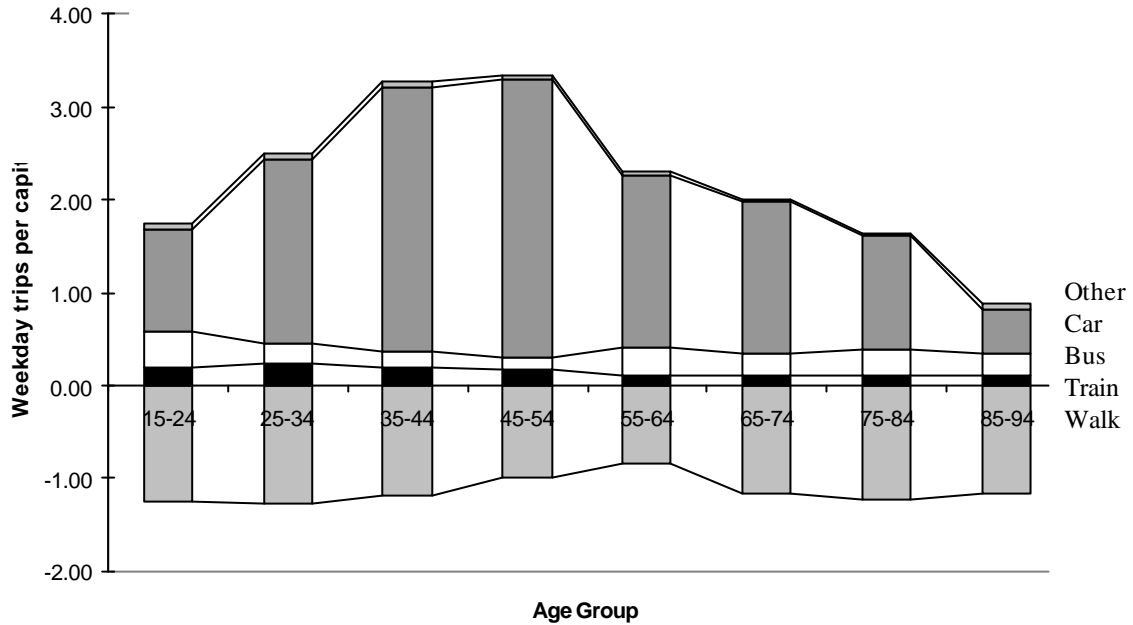
**Figure 2** shows variation in trip-making by age rather than sex. For the Greater Sydney metropolitan area, the number of daily trips per capita in each age band are shown above the X-axis for vehicular trips, including cycling, and below it for walk trips

Bicycle use does not feature in **Figure 1** - only in the 15-25 age group would it be of sufficient magnitude to be barely visible as a component of "other" travel. Propensity to walk remains fairly steady throughout life. The current dominance of the motor car is evident for all age groups. Of some interest is the drop in car use in the 55 to 65 age group - in fact occurring mostly in the younger half of this age group. In this group, there is a notable drop in total mobility, perhaps indicating the lifestyle challenges which arise when leaving the highly car-dependent years of middle life.

The lack of success of the bicycle in Australia in catering for general urban movement was emphasised recently by a recent article in *Australian Cyclist* (May-June 1998). Ron Shepherd asked "Can we have Dutch-style levels of cycling in Australia?". The answer was basically no (although a future with different energy imperatives was not canvassed), and a table comparing cycling in Melbourne and Amsterdam clearly brought out the cultural differences between the two locations (as per **Table 4**).

**Figure 1 - Mobility by Age and Mode in Greater Sydney 1991**

Source : Kilsby & Flynn (1995)



**Table 4 - A comparison of cycling in Amsterdam and Melbourne**

Source : Shepherd (1998)

	Amsterdam	Melbourne
Distance from outskirts to city centre	7-8 km	45 km (south-east) 20 km (west)
Population density	75/hectare	24/hectare
Cycling as fraction of total trips	30% (estimated)	1.5% (Transport Research Centre data for 1994-96)
Other modes of travel in priority order	tram, car, train, bus	car, train, bus, tram
Who rides bikes	adults, mainly women	adults, mainly men
Purpose of travel	utility more than recreation	recreation more than utility
Where bikes are ridden	bike lanes, also paths	main roads, also paths
Typical speed	15-20 kph	20-25 kph

	Amsterdam (estimated)	Melbourne (measured)
Usual type of bike	old 28" wheel roadsters	mountain bikes and some racers
Fittings on bikes	lights, mudguard, lock, stand, chainguard, luggage racks	brakes, derailleur gears
How luggage is carried	rear rack, basket	back pack, plastic bag on handlebars
Usual clothing	normal clothes	special lycra costume and cycling shoes
Helmets ?	no	yes
Adverse weather	snow, ice in winter	hot in summer, rain any time

In Australia cycling is to a large degree promoted as an opportunity for consumerism, calling for high-tech equipment and fashionable clothing (and an unfashionable helmet), rather than something ordinary and useful. For it to become a more prominent mode in Australian cities, or indeed

anywhere without a strong cycling tradition, it needs to become perceived as an everyday utility action rather than something that has to be prepared for specially.

### **Cars-R-U**

This marginalisation of cycling also applies to walking, to a considerable degree. We have built our worlds around the motor car. Freund and Martin (1993) described the situation with some passion, and a good thesaurus :

*The auto's appeal partially lies in its deep embeddedness in our cultural and psychosocial experiences as an icon of individual mastery over technology, of individual freedom, of power and speed, of social status, and of sexuality. Individualist and consumerist ideologies*

*mystify the problems engendered by auto hegemony, including environmental degradation ; transport disenfranchisement of populations, even in the fully industrialised world; intense resource and energy use ; bodily mayhem and more subtle health problems ; and distortions in the fabric of social life, particularly the loss of public space and street life. A phenomenology of automobility reveals landscapes which promote a sense of sameness and placelessness, as well as a confusion of image and reality, the essence of post-modern visual sensibility. The very social organisation of space that auto-centred transport fosters helps to further auto-dependence and to mask any sense of realistic alternatives to automobility.*

One aspect of this attitude is an on-going debate in institutional circles about whether a bike is a legitimate road vehicle or not. The conclusion is seen to have implications for regulations, funding and so on. In practice, though, the answer is probably yes and no. A cyclist has the ability, if not always the permission, to switch instantaneously from being a motorless motorcyclist on a road to being a wheeled pedestrian on a footpath, or back again. Or, if they are lucky, to being a cyclist on a cycleway. Traffic regulators tend to regard this unique attribute as anarchic and usually try to suppress it, unless it saves money (for instance where designated cycle routes include flights of stairs).

Many of the intangible costs of a car-dependent society are well-known - pollution, congestion, road trauma. There is growing appreciation of health-

related costs. Austroads (1998) quote findings that quantify these costs in Australia (\$1.3 billion in 1993-94 dollars per annum associated with overweight and obesity) and British findings that "for every year of life lost through cycle accidents, there is 20 years gained through increased health and fitness". There are other such costs where research is still embryonic, alluded to in the Freund and Martin quote above.

Even the terms generally used to describe walking and cycling by planners are value-laden, a part of this unconscious acceptance of motorised primacy.

The most usual term is "non-motorised transport". Defining something by what it is not brings to mind the position of non-whites in the old South Africa. Sometimes the term is the similarly loaded "Slow Modes". In other forums I have suggested referring to this as the CHIEF sector - because it is Cheap, Healthy, Independent, Equitable and Fun. The thought of the Chief Transport Planner in an organisation being the person responsible for pedestrian and cycling issues has considerable appeal. "Green Modes" is another alternative. They are also value-laden labels, but no longer derogatory.

Finally, this cultural structure of course imposes very practical constraints on change.

The anticipated scarcity of oil supply will be a chronic condition when it eventually arises. However, acute crises can arise as well as chronic ones, with implications for national security. The world has already seen what can happen when major urban areas are suddenly deprived of oil. The USA and the Netherlands were two countries singled out for the Arab oil embargoes in 1974, and it is interesting to compare their responses. In Dutch cities, society decided to eke out its scarce supplies not only by fuel rationing but also by doing without cars almost entirely on one day a week (*autoloze zondag* - car-free Sunday). With a strong cycling tradition and facilities in place, they took to it in great numbers on Sundays, and enjoyed themselves so much that consideration was given to retaining this practice as a permanent feature of Dutch urban life. At the same time, there were reports of desperate motorists in the US shooting each other in unruly queues at gas stations.

### **The Stakes**

We saw earlier that short distance car travel - under 3 km - accounts for roughly 7% of fuel consumption in big cities.

Three kilometres is of course an arbitrary distance which happens to suit the way in which travel data is reported in Sydney and Melbourne. It would take an ordinary cyclist about ten minutes to travel that far, and most regular cyclists would consider it a trivial distance.

Most of the population are not regular cyclists (yet). If for the moment we assume that three kilometre trips or shorter are the domain in which cycling might offer options for non-cyclists, then clearly urban energy shortages are not going to be materially affected by a switch to cycling on its own. While saving a percentage of 7% would be useful, it is not going to significantly alleviate any future major shortage of oil-based fuels.

However, were such shortages to develop, then the policy response would presumably be an integrated one. It would include other measures such as greater use of gas or other fuels for transport, and measures to reduce the total amount of travel. The latter are already being applied in Australian cities, because of congestion and air quality issues. Energy shortages would add an additional imperative to current strategic directions.

Extension of the simple calculations at the beginning of this paper shows the potential rewards from an integrated strategy.

- Converting (say) half of the car trips under 3 km to human power would save 3.5% of fuel consumption by cars in the city - a positive achievement but probably of insufficient magnitude to change the nature of the potential energy shortage.
- Assume also an integrated transport and land use policy with other measures that succeed in (say) converting half the car trips more than three kilometres in length to less than three kilometres. If fuel became a scarcer resource, price rises would contribute to this but it would also call for some adjustment of physical urban layout to make shorter travel options possible.
- Under these circumstances, the former fuel consumption for the city could reduce by 47% (36% through shortening of trips and a further 11% by the mode change for short trips).

These numbers just demonstrate the synergy of the two approaches - it is not claimed that either target is achievable. The message is however clear. Human-powered transport on its own does not have strong potential to ease the effects of a future energy shortage. An integrated urban planning strategy will greatly amplify this potential.

There would also be a large number of beneficial side-effects were urban transport energy to be reduced in this way, including a healthier public,

more productive use of urban land, cleaner air, more viable public transport for longer trips. The downside would largely be felt by those in businesses, trades, professions or institutions which support the "technology-in-use" aspects of the car industry and would not or could not similarly support a successful "CHIEF" sector.

### Crystal Ball Gazing

The message so far is that greater encouragement of cycling may not alone make much difference to future energy demands in cities, although it may bring many other benefits such as improved community health. However, as one element of an integrated package of measures it also has greater potential to influence energy requirements. The principal barriers are not technological but behavioural and institutional.

But the world is changing fast. Will other changes reduce the potential for cycling or make it irrelevant ?

Is there some new technology in the wings waiting to transform urban mobility ? It is a long time since the last one appeared on the scene. Lawson (1998) reviewed such issues, concluding that :

*The analysis suggests that the era of dominance of surface transport by the automobile is now drawing to an end, and that it is reasonable to expect a new form of transport to come into being, involving new vehicles matched to a new infrastructure, and designed to meet new requirements, notably the issues of sustainability.*

He does not consider old vehicles matched to new infrastructure, despite noting the lack of success of the automobile itself in the period 1830-1900 because of infrastructure constraints. Will there be a resurgence of bicycling in the 21<sup>st</sup> century, with its intrinsic value finally recognised and given a place ? Or will bikes become a largely redundant reminder of a past era, as some might assert they already have ?

To illuminate this question, we need - if not a crystal ball - a long-term perspective.

Futurologist Hardin Tibbs recently took such a long term view of continuing rapid global change and the future of transport (Tibbs 1998). His review identified seven important strategic implications for transport. They are summarised below, with commentary added in the light of this paper.

- Continuing rapid global change overhangs local planning concerns, and these developments should be carefully monitored. (No argument there).
- Disaster contingency planning should be well developed. (Commentators have long warned of the dangers of “brittle power” - a system of energy use that requires centralised sources and a continuity of flow, and that lacks diverse options in the case of breakdowns. The role of cycling as an emergency option has already been noted in the US/Netherlands example quoted earlier).
- Materials intensity could decline and population become more dispersed. (A debatable conclusion. If correct, it would increase the importance of “off-grid technology” in new rural development, which includes human power in the transport sector).
- Existing policies aimed at reducing transport unsustainability should be continued. (Increased cycling is an important target for such policies)
- The long run target for pollution emission and carbon emission for the national transport fleet should be zero. (Emissions from cyclists are very small, even when beans are used as the power source)
- A sustainable economy would be likely to treat the supply of manufactured goods as a service business, stressing leasing rather than purchase. If applied to vehicles, this would blur the distinction between public and private transport (The bicycle has a unique capability for mixed-mode travel - it can be ridden independently, carried on public transport or even in car boots, or parked at stations).
- Technological developments that are likely to be a key part of future transport systems should be encouraged. (Here is an opportunity for Australia to develop the “Volksbike” and possibly other technology to benefit pedestrians and cyclists, to complement the very high speed trains, electric cars, automated people-movers and assorted Jetsons devices already envisaged by transport engineers).

With such holistic challenges facing us, encouraging greater use of human power in transport does indeed matter.

### **The Way Forward**

So how to make progress ? Austroads (1998) put forward for discussion some possible ways ahead, based on existing state, territory and overseas bicycle strategies. Their proposed basis for a national strategy provides a good ending for this review.

- Ensure planning for cycling is integrated within overall transport and land use planning.
- Establish partnerships that ensure a co-ordinated, integrated approach is used to implement this strategy and evaluate its effectiveness.
- Allocate resources that enable the partners to implement this strategy.
- Ensure that cyclists have access to facilities necessary for, and that encourage, safer cycling.
- Create a safer on and off road cycling environment.
- Develop and implement information campaigns that promote positive images of cycling.
- Undertake research on cycling issues that can be used to inform decision making.

If progress is made on the third of these items, in particular, this proposed strategy will truly be distinguished from the well-meaning but ineffective platitudes which have preceded it.

### **References**

- Austroads, 1998, *Cycling Australia - The National Strategy*. Community Consultation Paper.
- Freund P & Martin G, 1993, *The ecology of the automobile*, Black Rose Books, Montreal.
- Industry Commission, 1994, *Urban transport*. Report No 37. AGPS
- Kilsby D & Flynn L, 1995, *Transport provisions and concessions for older people in NSW*, Proceedings of the Fourth International Conference on Competition and Ownership in Passenger Transport, Rotorua.
- Lowson M V, 1998, *Surface transport history in the UK : analysis and projections*, Proceedings of the Institution of Civil Engineers - Transport, Vol 129 February 1998.
- Parker A, 1998, *Dutch levels of cycling : are they possible in Australia ?* Australian Cyclist April-May 1988
- Shepherd R, 1998, *The decline of bicycle commuting*, Australian Cyclist, April-May 1998.
- Tibbs H, 1998, *Global change and the future of transport*, Road and Transport Research Vol 7 No 2 June 1998.
- Transport Data Centre, 1996, *1991 Journey to Work Summary Tables*, Report 96/4, Sydney.
- Transport Data Centre, 1994, *1991 Sydney Region Travel Surveys : Home Interview Survey Results*, Report 94/6, Sydney.